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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/249,292	02/12/1999	TETSUO ONO	503.36911CX1	9771
20457	7590	03/19/2004	EXAMINER	
ANTONELLI, TERRY, STOUT & KRAUS, LLP			OLSEN, ALLAN W	
1300 NORTH SEVENTEENTH STREET			ART UNIT	
SUITE 1800			PAPER NUMBER	
ARLINGTON, VA 22209-9889			1763	

DATE MAILED: 03/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/249,292	ONO ET AL.	
	Examiner	Art Unit	
	Allan Olsen	1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 December 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4,30-32 and 34-36 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,4,30-32 and 34-36 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 4 and 30-32 and 34-36 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. 5,352,324 issued to Gotoh et al (hereinafter, Gotoh).

Gotoh teaches a method of etching a substrate. Gotoh teaches applying a high frequency RF bias to the substrate (column 8, lines 25-26, claim 3). As noted in the Office action of August 15, 2003, the industry recognized definition for the lower limit of the "high frequency" range is about 4 MHz. Further support for this is provided by Collins in US Patent 6,068,784, column 11, lines 60-61). Therefore, Gotoh teaches applying an RF frequency above about 4 MHz, which reads on Applicant's claimed bias frequency of "at least 100 kHz". Gotoh teaches that the power supply for the high frequency bias is controlled independently from the power supply that is used for generating the plasma (column 8, lines 24-26). Gotoh teaches on-off modulating the bias frequency with a duty ratio of between 2% and 50% (figures 5 and 6; column 9, lines 23-25). Gotoh teaches that the frequency of the on-off modulation should be 1000 Hz or less (column 7, line 65 – column 8, line 2), which reads on Applicant's claimed frequency of "at least 100 Hz". Gotoh teaches etching a multi-layered substrate wherein during the initial etching phase a second layer, which underlies a first layer, is not initially exposed. Claim 1 requires the on-off modulation of the bias power in a first

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period etching wherein the etching selectivity in the first period is less than the etching selectivity during a subsequent etching period. Whereas the etching selectivity modulates inversely with the modulation of the bias power (i.e. high bias/low selectivity), during each on-off cycle there is a period of relative low selectivity (i.e., bias on), which is followed in a subsequent on-off cycle by a period with a higher selectivity (i.e., during the bias off).

Claim 1 requires the frequency of the applied bias to be such that the distribution of the plasma's ion energy includes a peak in each of the high energy and low energy regions. Applicant's figure 5 is a graph profiling the ion energy distributions that are obtained from the application of two different bias frequencies. When a high biasing frequency is applied (e.g. 100 kHz) the graph shows that there are many ions with high energy and many ions with low energy, that is, the distribution of ion energies is largely bimodal in character. Claim 30 includes a limitation pertaining to the ion energy distribution profile, specifically it requires that the number of ions at a high and low energy value be at least twice the number of ions at an intermediate energy value. Applicant has demonstrated (see figure 4) that this is inherent when a high frequency bias, such as that taught by Gotoh, is applied to the substrate.

Also considered to be inherent is the limitation of claim 1 requiring the peak to peak voltage of the modulated bias power be set to a level such that the etching rate obtained that is obtained when the bias power is modulated is equal to the etching rate that would be obtained by providing a continuous bias having a smaller peak-to-peak voltage. As before, the examiner maintains that etching rates modulate in conjunction

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with the modulation of bias power such that the bias-on state provides higher etch rates relative to the bias-off state. Therefore, the on-off modulation of bias power brings about a decrease in the overall etch rate as compared to the same process being carried out with a continuous supply of bias power. On the other hand, etching rates increase when the peak-to-peak voltage of the bias power is increased. The on-off modulation of bias power causes etch rates to decline and increasing the peak-to-peak voltage causes etch rates to rise. Therefore, to satisfy the limitation that requires achieving the same etching rate for a bias modulated process and a continuous bias process, the peak-to-peak voltage in the bias modulated process must be increased to compensated for the reduction in the etch rate that is brought about by the bias power modulation.

Response to Arguments

Applicant's arguments filed December 15, 2003 have been fully considered but they are not persuasive.

Applicant argues that Gotoh does not teach a bias frequency of at least 100 kHz. Applicant points to column 8, lines 11-14, where Gotoh mentions applying a bias with a frequency of 1 kHz or more. Applicant's position is that Gotoh's teaching of using an RF bias with a frequency of 1 kHz or more is not a teaching of Applicant's claimed minimum of at least 100 kHz. While the Examiner believes that Gotoh's "1 kHz or more" provides for the claimed bias frequency of "at least 100 kHz", the Examiner finds it useful to consider the context in which Gotoh recites a frequency of 1 kHz. The paragraph bridging columns 7 and 8 concludes that it is preferable for the switching frequency (i.e., the frequency at which the on-off cycle repeated) is 1 kHz or less. After recognizing the

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important role of a low frequency, the next paragraph addresses the results obtained by simply applying a low frequency bias. Gotoh teaches that simply applying a low frequency bias does not provide the desired results - that is, unless one also applies the on-off modulation technique of Gotoh's invention. In this discussion Gotoh expressly denotes a 1 kHz frequency as being a low frequency. In contrast to the 1 kHz bias frequency of column 8, lines 11-14, Gotoh subsequently teaches applying a high frequency bias (column 8, lines 23-26). The teaching of column 8 (lines 11-14) simply demonstrates that the on-off modulation technique is beneficial even when used in conjunction with a bias frequency as low as 1 kHz. With the recitation of a bias frequency of 1 kHz or more, Gotoh demonstrates the breadth of utility for the on-off modulation technique. However, Gotoh clearly teaches using a bias with a high frequency (i.e., at least about 4 MHz, such as the typically applied, and FCC mandated, 13.56 MHz). Additional arguments made by Applicant are addressed in the above rejection.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The references cited on the attaches PTO form-892 each represent 102-type prior art against at least some claims. However, in view of the foregoing rejection, these references are not relied upon at this time.

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

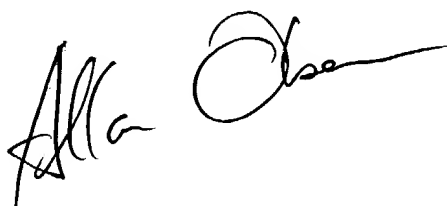
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TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is 571-272-1441. The examiner can normally be reached on M-F 1-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Greg Mills can be reached on 571-272-1439. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Allan Olsen', with a stylized flourish at the end.

Allan Olsen
Primary Examiner
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